CIAT | November 2018

A Roadmap for Latin America and the Caribbean

The International Center for Tropical Agriculture (CIAT), a CGIAR research center operating in Africa, Asia, and Latin America is headquartered in Cali, Colombia. CIAT has worked in collaboration for 50 years with hundreds of partners across Latin America and the Caribbean (LAC).

We work with government agencies and other partners on the ground providing tools and scientific and technical support for implementing eco-efficient agriculture at scale. CIAT's research in LAC helps better understand and harness current and future trends and their links to food security, nutrition, natural resource management, climate change, landscapes, and eco-efficiency in the agri-food sector.

Currently active in 14 countries in Latin America and the Caribbean, CIAT plays a valuable role in South-South transfer of agricultural knowledge and learning across the region and globally to accelerate innovation for development impact.

Regional trends shaping the agricultural sector

Our **research agenda** for LAC

- **Food systems**
- **Agroecosystems and landscapes**
- **Climate resilience**

Impact through

- **Thought leadership**
- **Partnerships**
- **Sub-regions and regional networks**
- **Alignment with CGIAR and the UN Sustainable Development Goals**

A rice trial field at CIAT's headquarters in Colombia (Neil Palmer/CIAT).

CIAT in Latin America and the Caribbean

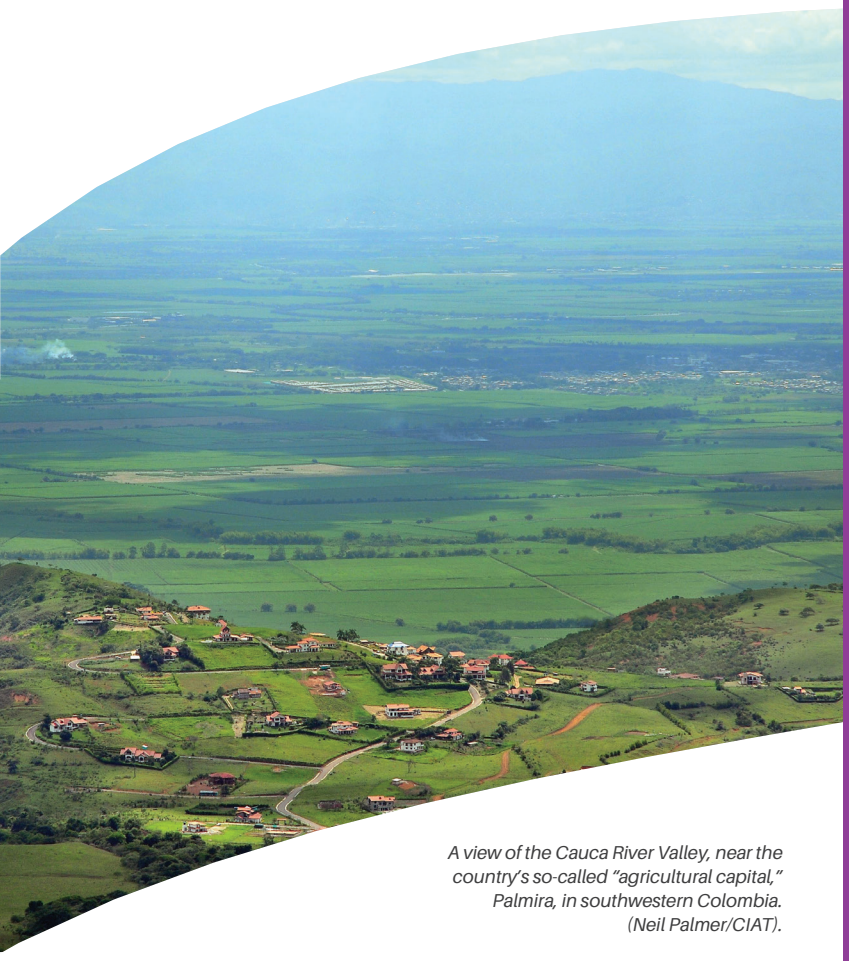
The International Center for Tropical Agriculture (CIAT), a CGIAR research center operating in Africa, Asia, and Latin America, is headquartered in Cali, Colombia. CIAT has worked in collaboration for 50 years with hundreds of partners across Latin America and the Caribbean (LAC). During this time, CIAT has led the development and dissemination of technologies, innovative methodologies, policy design, and new knowledge that better enable farmers – small, medium, and large – to enhance eco-efficiency in agriculture, contribute to increased prosperity, and improve human nutrition through research-based solutions in agriculture and the environment. A core area of collaboration between CIAT and national partners in the region has been in crop improvement for beans, cassava, rice, and tropical forages. The adoption of CIAT-related varieties alone in Latin America and the Caribbean over the past 50 years has generated economic benefits estimated at US$16.3 billion in beans, US$10.8 billion in rice, US$2.3 billion in cassava, and US$1.58 billion in tropical forages.[1, 2]

CIAT's global research team consists of more than 350 professional staff, with 119 scientists based in Latin America and the Caribbean (LAC) at CIAT's headquarters and the main regional hub in Cali, Colombia, as well as in country offices in Nicaragua, Honduras, and Peru. CIAT's research team in LAC brings together a wide range of disciplinary expertise in crop improvement, socioeconomics and policy, market access and agribusiness development, agro-ecology and crop management, integrated farming systems, sustainable land use, nutrition, seed systems, soil science, and climate change adaptation and mitigation. CIAT's genebank in Cali, Colombia, is at the heart of the Center's efforts to make tropical agriculture more productive and resilient. It conserves the world's largest collections of key tropical crops, namely, beans, cassava, and tropical forages.

1 Figures are in 2011 US dollars.
2 CIAT. 2017. The impacts of CIAT's Collaborative Research. Centro Internacional de Agricultura Tropical, Cali, Colombia.

A new initiative, **Future Seeds**, is a state-of-the-art genebank under development to ensure the continued protection of humanity's priceless reservoir of crop diversity. Future Seeds also enables innovations in genomics and big-data technologies for a more data-driven and targeted use of crop diversity by expanding the digital dimension of the genebank. Located in the midst of a global biodiversity hotspot, Future Seeds serves as a platform to convene genetic resource scientists from around the world.

Partnerships are at the core of CIAT's strategy in the region. Our mandate to achieve impact at scale means that we work with government agencies and other partners on the ground providing the tools and scientific support for implementing eco-efficient agriculture at scale. CIAT's research in the region helps to better understand and harness current and future trends and their links to food security, nutrition, natural resource management, climate change, landscapes, and eco-efficiency in the agri-food sector. Currently active in 14 countries in LAC and more than 50 worldwide, CIAT plays a valuable role in South-South transfer of agricultural knowledge and learning across the region and globally to accelerate innovation for development impact.



A view of the Cauca River Valley, near the country's so-called "agricultural capital," Palmira, in southwestern Colombia. (Neil Palmer/CIAT).

An **alliance** with Bioversity International

To meet the growing demand for research-for-development solutions at a greater scale and within a time frame that is commensurate with rapidly changing global challenges, CIAT is establishing an Alliance with Bioversity International, a sister CGIAR center with a complementary mandate, strategy, capacity, and presence on the ground.

This Alliance will develop and deploy evidence-based solutions to build sustainable, resilient food systems and landscapes. This will include making better use of agricultural biodiversity, producing food in the face of climate change, reducing the environmental footprint of agriculture, and ensuring a vibrant agricultural sector that drives prosperity, economic development, and improved human health and nutrition.
This roadmap capitalizes on the synergies and complementarities of CIAT and Bioversity International to deliver on these opportunities in Latin America and the Caribbean. As the program of the Alliance evolves within the region and new opportunities emerge, it is expected that changes may have to be made to the roadmap. By releasing it now, it is intended to guide the work of CIAT during this period of transition and institutional innovation, so as to maintain a strong and forward-looking program as the priorities and arrangements evolve.

Regional trends shaping the agricultural sector

The following trends are expected to drive transformation of the agricultural sector in Latin America and the Caribbean in the coming decade and will, therefore, have relevance for CIAT's research agenda:

Strengthened role of LAC in the global food system as a food exporter

Latin America is the largest net food-exporting region and, as such, will be subject to pressure related to productivity, low value-added, dietary transformations globally, foreign investments in agriculture and land, and higher social, environmental, and economic standards within the global food industry. Agriculture and food production will remain important economic sectors in many countries in the region, although their relative importance for GDP and related workforce will vary across countries.

Water stress

As agriculture uses more than 50% of the water in the region, an immense opportunity arises to innovate in water-efficient production systems and water conservation in agricultural landscapes. Water is emerging as an important framing discourse for policies and practices in agriculture, and continued access for small farmers will be challenged while their agricultural livelihoods will depend more on water availability.

From food security and hunger to nutrition security, obesity, and food safety

Pockets of malnutrition, lack of sufficient calories, and hidden hunger will persist, particularly where agriculture and self-provisioning are important to food security. Yet, at the national level in many countries, obesity will replace hunger as the major health challenge, with increasing diabetes and other diet-related noncommunicable diseases affecting rural and urban poor.

Funding shift for agriculture: from ODA to loans/ investments; from agriculture to environmental services; and from public to private sector

There is an increasing need for economic analyses that support investment, understand risk, mobilize finance, and are able to consider ecosystem service provision in economic terms.

The digital and mobile technology revolution

is hitting LAC rapidly. Agriculture, particularly small-farm agriculture and public-sector entities, including technical assistance programs, needs to be a part of this change. There will be important opportunities to piggyback on advances in other sectors to quickly bring agriculture into the digital era.

Recognized role of LAC in the provision of environmental services globally

Important incentives exist for conservation of biodiversity, water, soils, forests, other ecosystem services, and landscapes. Increased pressure is present for agricultural development to be compatible with sustainable use, valuation, and conservation of natural resources.

Climate as a strategic issue

(and real challenge) for economic and agricultural development focuses on long-term climate changes as well as increased short-term climate variability and exposure to extreme weather events. Production landscapes and communities that are resilient in these three contexts will be the architecture of the future.

LAC will be the most urbanized region in the world by 2030 and will remain so.

Urban consumers drive the food system. Yet half of these urban consumers are located in a mosaic of small and mid-sized cities, and growing small towns surrounded and serviced by rural areas. These small and mid-sized cities are experiencing higher growth rates than the larger megacities.

Local, national, and regional food markets will remain important

for producers and consumers in the region, particularly lower income groups. The private sector, including large agribusiness, food processors, and retailers, will have an increasingly important role in the regulation of the food and agricultural sectors vis-à-vis the public sector.

Rural transformation

The growth of medium and large farms, and large agribusiness alongside a continued small-farm sector will have implications for household livelihood strategies, inequality, and rural economies. The demographic transition in rural areas will be toward older and fewer farmers, along with rural-urban and overseas migration, including of youth. Policies, programs, and research will need to differentiate between these groups as end-users.

Uneven institutional capacity for innovation in agriculture

National agricultural research and extension systems (NARES) and national innovation systems across Latin America are heterogeneous, with a growing gap between a handful of strong well-resourced NARES with strong links to the private sector and the majority of small NARES with limited capacity that will require differential strategies.

Shifting policies in response to new priorities and challenges

Health policies, including taxes on unhealthy food and new labeling requirements, economic development policies that strengthen the agricultural sector and sustain the region's potential as a key provider of global environmental goods, and trade policies that respond to shifting global relations will all create potentially conflicting incentives for the agricultural sector.

Increasing inequality

With poverty rates decreasing and GDP per capita increasing, mostly in urban areas, the unequal distribution of wealth will remain as a main development challenge in the region.

Upland farmer in Bolivia (Neil Palmer/CIAT).

CIAT's Research Agenda for Latin America and the Caribbean

Research theme 1: Food systems

Latin America and the Caribbean (LAC) is home to countries that top the lists for obesity; on average over the region, 60% of consumers are overweight. These numbers, along with incidence of diabetes, are growing fast and women are most affected.[3,4,5] Undernourishment in LAC is lower than in other regions (6.6%),[6] yet, within LAC, some countries have levels of undernourishment as high as 40%.[7] Obesity, undernourishment, and hidden hunger co-exist within many countries in the region. Transformations in market systems and dietary changes are occurring rapidly and the private sector plays an increasingly important role in food production, processing, and retailing as LAC consolidates its position as the main net exporter of agricultural and food products globally.[8] Moving forward, we will need to breed crops with higher nutritional quality while continuing our breeding to develop varieties that are high yielding, adapted to a variety of environments, and resilient to multiple stresses. Although there will be a focus on CIAT's core crops (beans, cassava, rice, and forages), high-value crops (coffee, cacao) and food systems as a whole will also be targeted.

3 FAO and PAHO. 2017. Panorama of Food and Nutrition Security in Latin America and the Caribbean. Santiago de Chile.
4 https://ourworldindata.org/obesity#adult-obesity-by-region
5 Obes Rev. 2018 Apr 24. doi: 10.1111/obr.12694. [Epub ahead of print] Obesity and the food system transformation in Latin America. Popkin BM1, Reardon T2.
6 http://www.fao.org/americas/publicaciones-audio-video/panorama/es/
7 FAO and PAHO. 2017. op. cit.
8 Díaz-Bonilla et al. 2014. Global Strategic Trends and Agricultural Research and Development in Latin America and the Caribbean: A Framework for Analysis. Cali, Colombia: International Center for Tropical Agriculture (CIAT). http://hdl.handle.net/10568/58316

We believe that agriculture (supported by key policy instruments) has an enormous potential to catalyze processes of socioeconomic inclusion in rural areas and address the structural causes of social and political unrest in many countries of the region. We will need to deepen our understanding of the market systems that serve the poor and how they affect nutritional outcomes, income generation, and the equal distribution of benefits for rural and urban poor and for producers and consumers. This will require research and innovation on traditional market systems, on food environments, on nutrition information policies to incentivize healthy consumer choices, and on institutional arrangements that support positive nutritional outcomes through consumption, including delving more into the rural-urban food nexus and linking with urban development initiatives connected to food, including urban agriculture and food labeling.[9]

Research agenda

- **Addressing the triple burden of malnutrition**
  This includes crop and varietal development in CIAT's core crops with a nutritional focus; work on contaminants and food safety-related production practices; tackling malnutrition through nutrition innovation strategies such as biofortification; research on adoption and scaling to understand and improve nutrition outcomes for different households and family members with particular emphasis on gendered roles; and support to ministries on policy innovation.
- **Productivity and profitability growth**
  This includes understanding and closing the yield gap for priority crops through varietal, agronomic, or systems research; production systems and breeding research to improve the productivity of land, water, labor, biodiversity, and financial capital; and integrated livestock-cropping systems and agroforestry. This research needs to consider technological innovations that serve youth and women farmers in particular, and target small- and medium-sized farms where returns to innovation are high.
- **National and regional food system analyses**
  This includes the development of indicators and tools for assessing food systems in terms of nutritional, food safety, resilience, and equity outcomes and trade-offs to guide policy interventions; characteristics and drivers of the food environment for poor consumers; and analysis of health, nutrition, and policies to drive innovation in megacities.
- **Market systems and value chains**
  This includes research on nutrition and gender-sensitive, inclusive, climate-resilient, and environmentally sound (i.e., deforestation-free) value chains and business models; research on the traditional food sector and local market systems; and improving the profitability and sustainability of production systems while reducing environmental footprints.

Partners

New partnerships will include the health, medical, food science/processing/safety sectors, supporting countries to reframe their understanding of the connections between agriculture, food, and health, as well as how to regulate and articulate appropriately those sectors for improved nutrition and poverty reduction outcomes. Private-sector actors, including traders, processors, retailers, farmer organizations, commodity boards, and traditional market actors; international trade integration or private-sector roundtables such as WEF and ICCO/ICO; and international initiatives such as Food-Smart Cities and the UNEP 10YFP SFS program will be important partners in this research agenda.

Biofortified crops make their way into the region

Until October 2018, more than 290 biofortified varieties of 12 staple crops had been released or were undergoing a testing phase in over 60 countries across the world. Latin America and the Caribbean has also benefited from the development of more nutritious crops. Just in 2017, eight nutritionally improved varieties were released, including beans, rice, cassava, maize, and sweet potato.

Seed and commercialization specialists are working together in value chains to introduce and fast-track adoption of biofortified crops. Such is the case of Colombia, where a national program is being implemented to encourage farmers to shift from illegal crops to staple food crops. Today, seeds are being produced to enable 10,000 Colombian households to harvest the benefits, both nutritional and economic, from biofortified crops.

9 For example, focusing on high levels of sugar, fat, and sodium content. Chile and Mexico are pioneers in the region on this front.

Research theme 2: Agroecosystems and landscapes

Water stress, climate change, biodiversity loss, deforestation, and land degradation are increasingly important concerns within the international community as well as for national and regional governments in LAC. LAC holds important wilderness and biodiversity areas. Governments and private-sector actors are gaining awareness that productivity growth in agriculture for its own sake is insufficient and large-scale public and private investments are increasingly being reoriented around environmental indicators of concern. Landscapes for sustained provision of environmental services where productive and conservation purposes are reconciled and integrated are receiving growing attention at the expense of a purely productive focus for rural development. Climate change has challenged commodity traders to invest in supply chain resilience and environmental performance with a focus on long-term stability of the supply.

Moving forward, CIAT's work on agricultural production systems and landscapes for LAC will need to more tightly link short- and long-term system productivity and profitability, incorporating green growth indicators and the provision of ecosystem services, thus generating quantifiable contributions to country and regional climate, poverty, and resource conservation goals. The region will need more solutions that lean toward sustainable productive landscapes where agriculture and functional restoration are integrated, showing how agricultural sector development contributes positively and verifiably to national and international commitments such as the nationally determined contributions (NDCs).

Water will be particularly important as agriculture uses 70% of the water in the region.[10] Much more research is needed on water-efficient irrigation infrastructure and supportive policies, as well as on water resource management more broadly that supports diverse uses for agriculture, households, energy, and industry.

Boosting ecosystem services and restoration in LAC

The sustainable production system known as **Quesungual** has been successfully implemented in the Central American Dry Corridor for soil, water, and vegetation management. Hundreds of farmers have increased their yields of maize and beans, while improving ecosystem services and resilience.

CIAT has also been working in Central America in actions towards improving water availability and developing tools aimed to inform investments in water harvesting for agriculture. In Peru, CIAT's research to assess the value of ecosystem services was key to passing a law that promotes mechanisms for equitable sharing of economic benefits from nature.

Research agenda

- **Agro-ecological practices**
  This includes developing and promoting the adoption of agro-ecological practices at plot, farm, and landscape levels that make more efficient use of water and nutrients, conserve biodiversity, reduce pest problems (i.e., biological controls), restore soils, landscapes, and ecosystem services, and that promote integrated agrosilvopastoral systems.
- **Landscape-level restoration of degraded ecosystems**
  This includes the design and implementation of productive landscapes that support livelihoods, biodiversity, and ecosystem services, with emphasis on water, carbon, and greenhouse gases for specific sites; with a target on critically degraded areas with potential for agriculture and the provision of ecosystem services that foster community-based activities; and making use of sustainable business models.
- **Water efficiency**
  Broadening our research agenda on water-smart agriculture and water-smart agricultural landscapes, including sustainable irrigation investments, water-efficient technologies, agronomic practices, and engagement with irrigators' associations for water-use efficiency and watershed management.
- **Quantification and economic valuation of ecosystem services**
  Innovating with digital tools and refining methods for quantification, monitoring, and economic valuation of ecosystem services; measuring the impact of technologies and interventions such as land restoration to guide investment planning and policy-making for the public and private sectors.

10 www.fao.org/americas/prioridades/suelo-agua/en/

Partners

Much stronger collaboration with the environmental sector will be important, including UNEP, ministries of the environment, and other environmental agencies, global and regional environmental NGOs, as well as participation in environmental debates, building the bridges to agriculture and facilitating South-South cooperation. Engaging with indigenous peoples in the region, who are both farmers and stewards of large tracts of forests, presents an opportunity for collaborative, participatory research, outreach, and on-the-ground implementation of knowledge products.

Research theme 3: Climate resilience

Latin America and the Caribbean is highly vulnerable to climate change, climate variability, and extreme weather events. The importance of the agricultural sector for the economies of South and Central America in terms of employment, rural economies, GDP, and food security makes climate change a very real and imminent threat for the region. Land-use change and degradation, particularly the advance of the agricultural frontier and the expansion of extensive livestock grazing systems, are accelerating the effects of climate change in the region. Climate commitments are increasingly central to the agendas of many governments in the region.

CIAT's capacity and leadership in the area of climate change and agriculture make us a key partner in the region for helping countries convert climate change and variability into an opportunity for sustainable growth in the agricultural sector. To do this, CIAT must focus more heavily on the economic case for climate-resilient agriculture in the short and long term, informing investments and financial instruments to unlock the sector's potential.

Research agenda

- **Technologies for adaptation to climate change**
  This includes promoting the development and adoption of varieties tolerant of drought/high temperature/and flood, agronomic practices that promote adaptation and mitigation, and production systems resilient toward climate change and variability.
- **Low-carbon climate-resilient pathways**
  This includes support for countries in the region to comply with their NDCs, develop national adaptation plans (NAPs), and foresight for sector planning.

Climate resilience

CIAT has been a leader across the region in developing climate services for the agricultural sector, designed to minimize crop losses to climate variability, reduce risks for farmers and enable greater profitability for farm enterprises. Our work in Colombia has won numerous international awards for its novelty and development impact, and CIAT is engaged across much of the region in the design and deployment of new services. The approach introduces farmers to new skills, best practices, and knowledge on how to incorporate local, reliable, and timely climate and site-specific information from trusted sources into their planning systems and strategies. In both Colombia and Honduras, up to 330,000 farmers have been reached through nine local technical agroclimatic committees, and in Colombia alone, more than 150 thousand farmers are receiving tailored agroclimatic advisory services, and an additional 6,000 have adopted climate-smart practices.

- **Agricultural risk management**
  This includes improved climate information services for agricultural investment planning; digital advisory services for improved crop management, including agro-climatic services for farmers; financial services and products, agronomic practices to reduce risk from pests and diseases as well as yield loss, and instruments for managing market risk such as agricultural insurance and the study of institutional arrangements at various levels.

Partners

New partnerships will focus on financial institutions, agricultural commodity traders and farmers organizations, building on current engagements under the **CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)**, but breaking through into product development and deployment by private-sector actors including development banks. Digital technology companies, extension service providers, national climate change offices, ministries of natural resources, and meteorological institutes will also be important partners.

CIAT phenomics scientists use drones to facilitate evaluation and physiological diagnosis of crops based on information captured in the field (Neil Palmer/CIAT).

Achieving Impact in Latin America and the Caribbean

Impact through thought leadership

We are facing a time of unprecedented change. CIAT will continue to innovate around the key pillars of eco-efficiency that aim to use resources more effectively to achieve sustainable increases in productivity; to help reduce the degradation of natural resources; and to create opportunities for boosting incomes and employment. Yet, the paradigm of agricultural development is shifting rather quickly from a focus on maximizing yield to more nutrient-rich crops. Further, there is now a trend for agricultural production to yield more and better crops but also in a fair and clean manner. In these times of change, CIAT will continue to be a leading-edge organization that promotes various strategies for sustainable development.

Impact through partnerships

CIAT's applied research for development should inform decision making, policy design, and practice. Partnership with national, regional, and local actors in research design, implementation, and application at scale will support efficiency and efficacy along the research to development continuum toward addressing some of the most important challenges facing the region. Capacity building within the region will continue to be an important component of CIAT's strategy in order to continuously transfer capacity to partners for both research and its application to development challenges. Key partners for CIAT to achieve impact at scale include INGOs, development banks, government institutions (including ministries of agriculture and environment, agricultural research institutes such as CATIE, and meteorological institutes, among others), the private sector, indigenous peoples' organizations, UN agencies, and donors. Multiple partnerships that integrate NARES, universities, civil society, the private sector, and development banks will be essential. Engaging with peer institutions and partners that influence the regional agenda, such as research institutions, intergovernmental organizations, and forums will also be critical.

Impact through sub-regions and regional networks

Within LAC, several sub-regions offer agro-ecological similarities that allow for cross-national/-regional research, exchange, or extrapolation of results, for example, Mesoamerica and larger Caribbean countries, smaller Caribbean island states, the Andes, the Amazon Basin, or the Southern Cone. These subregions also share similar challenges and priorities, as is the case for emissions reductions in the Southern Cone. Political and technical networks through regional integration institutions and platforms such as SICA, CARICOM, MERCOSUR, FONTAGRO, and INIAs-Iberoamerica can also facilitate capacity building, dissemination, and scaling-up of results and policy engagement, including South-South cooperation. Building from our base in the region within different agro-ecologies and sociopolitical networks, CIAT will maximize impact by working in and through these to reach scale and impact.

Impact through alignment with CGIAR and the UN Sustainable Development Goals

The three research themes of this roadmap link across CIAT's research areas and respond to CIAT's Strategy Update (2018–2020), to provide applied solutions in different agroecological and socioeconomic contexts, mobilizing knowledge from across the global South. As a member of the CGIAR System, CIAT, through this roadmap, aims to respond to the CGIAR Business Plan, harnessing knowledge-intensive transformations and strengthened collaborations with partners to tackle the changing global challenges. The proposed research agenda will make particular contributions to, and build on, the following CGIAR Research Programs: Agriculture for Nutrition and Health (A4NH), Climate Change, Agriculture and Food Security (CCAFS), Policies, Institutions and Markets (PIM), and Water, Land and Ecosystems (WLE), Roots, Tubers and Bananas (RTB), Forests, Trees and Agroforestry (FTA), as well as the Genebank and Big Data Platforms. Aligning our work to the UN Sustainable Development Goals allows us to work side by side with countries and other partners to reach a shared agenda around the future we wish to create. Although CIAT's work contributes in different ways to all 17 Sustainable Development Goals, 9 goals are particularly central to CIAT's mission and to this Roadmap, as shown below. CIAT will aim to design and apply actions that can address several development challenges simultaneously to contribute to multiple SDGs.

Climate-smart agriculture: coffee intercropped with pepper in the Andean region (Neil Palmer/CIAT).

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Cover photo / A thriving fruit and vegetable market in the town of La Plata, Huila Department, in the Colombian Andes (Neil Palmer/CIAT).